Brian Munsky

Center for Nonlinear Studies; TA-3, Bldg 1690, Room 117
Los Alamos National Lab; Los Alamos, NM 87545
email: `munsky@lanl.gov`
website: `http://cnls.lanl.gov/External/people/Brian_Munsky.php`

Education

⋄ **The University of California at Santa Barbara**, Santa Barbara, CA
Center for Control, Dynamical Systems, and Computation
Ph.D. in Mechanical Engineering; Advisor: Mustafa Khammash
Sep. 2003–June 2008; GPA: 3.86/4.00
Dissertation topic: *Modeling and Analysis of Stochastic Networks in Biological Systems.*

⋄ **The Pennsylvania State University**, University Park, PA.
M.S. in Aerospace Engineering, Advisor: Farhan Gandhi
Aug. 2000–Aug. 2002; GPA: 3.88/4.00
Thesis topic: *Fluid/Structural/Acoustic Analyses of Helicopter Blade-Vortex Interactions.*

⋄ **The Pennsylvania State University**, University Park, PA.
B.S. in Aerospace Engineering, Advisors: Farhan Gandhi and Ed Smith
Aug. 1996–May 2000; Junior/Senior GPA: 3.92/4.00
Honors thesis topic: *Active/Passive Damping Treatments to Alleviate Resonant Oscillations.*

Research Experience

⋄ **Richard P. Feynman Postdoctoral Fellow**, Center for Nonlinear Studies (CNLS), Information Sciences (CCS-3) and Advanced Measurement Sciences (B-9), Los Alamos National Lab.
In order to complement my engineering training, I am collaborating closely with physicists, information scientists, computational engineers and experimental biologists to develop and apply new computational and experimental techniques to improve understanding of single cell behaviors. Duties include: developing theoretical and computational tools, modeling diverse biochemical systems, interpreting biological data, designing single-cell experiments, writing grant applications, teaching summer school, and others (Jul. 2008 to Present).

⋄ **Graduate Research Fellow**, Department of Mechanical Engineering, UC-Santa Barbara.
Working closely with experimental biologists, I developed and validated a stochastic model of the Pap Pili epigenetic switch in *E. coli*. During the course of this research, I developed an array of new analytical tools to solve the master equations for discrete state, continuous time Markov processes (Jan. 2004 to Jun. 2008).

⋄ **Graduate Research Fellow**, Department of Aerospace Engineering, Penn State University.
As a research fellow at the Rotorcraft Center of Excellence (RCOE), I developed a Finite Element aeroelastic model to simulate a helicopter in forward flight. Working closely with other students, I coupled this model with a free wake aerodynamic analysis and an aeroacoustic prediction code. I used this model to study of the effects of helicopter flight trajectory on the noise due to Blade-Vortex Interactions (May 2000–Aug. 2002).

⋄ **Undergrad Research Assistant**, Department of Aerospace Engineering, Penn State University.
Using Finite Element Analysis, I performed parametric studies to ascertain the optimal design and control of an Active Constrained Layer Damping treatment with viscoelastic materials for the alleviation of resonant oscillations (May, 1999–May, 2000).

⋄ **Undergrad Research Assistant**, Department of Aerospace Engineering, Penn State University.
As a research assistant at the RCOE, I played a pivotal role in the analysis, design, and construction of a piezoelectric actuator for rotor blade trailing edge flaps (Jan. 1999–Aug. 1999).

Peer-Reviewed Journal Articles

Download full papers at: http://cnls.lanl.gov/External/people/Brian_Munsky.php

25) B. Munsky and M. Khammash, Identification of a Stochastic Model for the Genetic Toggle Switch, *To appear in IET Systems Biology*, 2010.

24) G. Bel*, B. Munsky*, and I. Nemenman, Simplicity of Completion Time Distributions for Common Complex Biochemical Processes, *Physical Biology*, **7**, no. 016003, Dec. 2009. *Contributed Equally. **Most read article at *Physical Biology* . Reviewed at *sciencedaily.com, biology-online.org, PhysOrg.com* and many others.**

23) B. Munsky*, I. Nemenman, and G. Bel*, Specificity and Completion Time Distributions of Biochemical Processes, *J. of Chemical Physics*, **131**, no. 235103, Dec. 2009. *Contributed Equally.

22) B. Munsky, B. Trinh and M. Khammash, Listening to the Noise: Random Fluctuations Reveal Gene Network Parameters, *Molecular Systems Biology*, **5**, no. 318, Oct. 2009. **Faculty of 1000 Biology Must Read and awarded the 2010 Leon Heller Postdoctoral Publication Prize.**

21) B. Munsky and M. Khammash, Transient Analysis of Stochastic Switches and Trajectories with Applications to Gene Regulatory Networks, *IET Systems Biology*, **2**, no. 5, pp. 323-333, Sept. 2008.

20) B. Munsky and M. Khammash, The FSP Approach for the Analysis of Stochastic Noise in Gene Networks, *IEEE Trans. Automat. Contr./IEEE Trans. Circuits and Systems: Part 1*, **52**, no. 1, pp. 201-214, Jan. 2008.

19) B. Munsky and M. Khammash, A Multiple Time Interval Finite State Projection Algorithm for the Solution to the Chemical Master Equation, *J. Comp. Phys.*, **226**, no. 1, pp. 818-835, Sept. 2007.

18) B. Munsky and M. Khammash, Analysis of Noise Induced Stochastic Fluctuations in Gene Regulatory Networks, *J. SICE*, **46**, no. 5, pp. 405-411, May 2007.

17) S. Peleš*, B. Munsky* and M. Khammash, Reduction and Solution of the Chemical Master Equation Using Time Scale Separation and Finite State Projection, *J. of Chemical Physics*, **125**, no. 20, 204104, Nov. 2006. *Contributed Equally.

16) B. Munsky and M. Khammash, The Finite State Projection Algorithm for the Solution of the Chemical Master Equation, *J. of Chemical Physics*, **124**, no. 4, 044104, Jan. 2006.

15) B. Munsky, F. Gandhi and L. Tauszig, Analysis of Helicopter Blade-Vortex Interaction Noise with Flight Path or Attitude Modification, *J. American Helicopter Society*, **50**, no. 2, pp. 123-137, Apr. 2005. (Earlier version published as conference paper ref. 3).

14) F. Gandhi and B. Munsky, Effectiveness of Active Constrained Layer Damping Treatments in Attenuating Resonant Oscillations, *J. of Vibration and Controls*, **8**, no. 6, pp. 747-775, 2002. (Earlier version published as conference paper ref. 1).

13) F. Gandhi and B. Munsky, Comparison of Damping Augmentation Mechanisms with Position and Velocity Feedback in Active Constrained Layer Treatments, *J. of Intelligent Material Systems and Structures*, **13**, no. 5, pp. 259-326, May 2002. (Earlier version published as conference paper ref. 2).

12) L. Centolanza, E. Smith and B. Munsky, Design, Fabrication, and Experimental Testing of an Induced-Shear Piezoelectric Actuator for Rotor Blade Trailing Edge Flaps, *Smart Materials and Structures*, **11**, pp. 24-35, Feb. 2002.

Peer-Reviewed Conference Papers

11) B. Munsky and M. Khammash, Using Noise Transmission Properties to Identify Stochastic Gene Regulatory Networks, *Invited Paper: Proc. of the 47th IEEE Conference on Decision and Control*, Cancun, Mexico, Dec. 2008.

10) B. Munsky and M. Khammash, Computation of Switch Time Distributions in Stochastic Gene Regulatory Networks, *Invited Paper–Proc. of the 27th American Control Conference*, Seattle, WA, Jun. 2008. **Best Presentation Award. Airfare and registration paid by ACC Student Travel Award.**

9) P. Inglesias, M. Khammash, <u>B. Munsky</u>, E. Sontag and D. Del Vecchio, Systems Biology and Control – A Tutorial, 46th *IEEE Conference on Decision and Control*, New Orleans, LA, Dec. 2007.

8) M. Khammash and <u>B. Munsky</u>, Systems Theory Applications in Biology: From Stochastic Chemical Kinetics to Deterministic Model Invalidation, *Invited Paper–Proc. of the European Control Conference*, Kos, Greece, Jul. 2007.

7) <u>B. Munsky</u>, S. Peleš and M. Khammash, M., Stochastic Analysis of Gene Regulatory Networks Using Finite State Projection and Singular Perturbation, *Invited Paper–Proc. of the 26th American Control Conference*, New York, NY, pp. 1323-1328, Jul. 2007. **All costs paid by the ACC Student Travel Award and the UCSB Doctoral Student Travel Grant**.

6) <u>B. Munsky</u> and M. Khammash, A Reduced Model Solution for the Chemical Master Equation Arising in Stochastic Analyses of Biological Networks, *Proc. of the 45th IEEE Conference on Decision and Control*, San Diego, CA, pp. 25-30, Dec. 2006.

5) <u>B. Munsky</u> and M. Khammash, Modeling and Analysis of a Bacterial Stochastic Switch, *Proc. of the 14th Mediterranean Conference on Control and Automation*, Ancona, Italy, pp. 1-6, Jun. 2006.

4) <u>B. Munsky</u>, A. Hernday, D. Low, and M. Khammash, Stochastic Modeling of the Pap Pili Epigenetic Switch, *Proc. of Foundations of Systems Biology in Engineering*, Santa Barbara, CA, pp. 145-148, Aug. 2005.

3) <u>B. Munsky</u>, F. Gandhi and L. Tauszig, *Proc. of the 58th Annual Forum of the AHS, Acoustic Session*, **2**, Montreal, Canada, pp. 1531-1551, Jun. 2002. (revised version published as journal article ref. 14).

2) <u>B. Munsky</u> and F. Gandhi, *Proc. of the AIAA/ ASME/ ACSE/ AHS/ ASC Structures, Structural Dynamics, and Materials Conference*, Seattle, Washington, Apr. 2001. (revised version published as journal article ref. 12).

1) F. Gandhi and <u>B. Munsky</u>, *Proc. of SPIE Smart Structures and Materials*, **3989**, Orange County, CA, pp. 61-72, Mar. 2000. (revised version published as journal article ref. 13).

Selected and Invited Talks

⋄ Listening to the Noise: Random Fluctuations Reveal Gene Network Parameters, *Invited Talk, UC-San Francisco*, San Francisco, CA, Dec. 1, 2009 (Also presented at *UC-Berkeley* on Nov. 30, 2009, *Stanford* on Dec. 3, 2009, and MIT on Jan. 28, 2010).

⋄ Analyzing Stochastic Switches and Trajectories in Gene Regulatory Networks, *Invited Talk, University of Pittsburgh*, Pittsburgh, PA, Mar. 20, 2009.

⋄ Stochastic model validation for the Pap (pili) epigenetic switch, *Selected Talk: The 3rd q-Bio Conference on Cellular Information Processing*, Santa Fe, NM, Aug. 9, 2009.

⋄ Listening to the Noise: Random Fluctuations Reveal Gene Network Parameters, *Selected Talk: The 3rd q-Bio Conference on Cellular Information Processing*, Santa Fe, NM, Aug. 8, 2009.

⋄ Stochastic waiting times of complex biochemical reactions may exhibit universal behavior, *APS March Meeting*, Mar. 2009.

⋄ Sensitivity Analysis and Parameter Identification of Stochastic Gene Regulatory Networks using Finite State Projection Techniques, *Selected Talk: The Eighth International Conference on Systems Biology*, Long Beach, CA, Oct. 2008.

⋄ Finite State Projection Solutions to the CME Arising in Gene Regulatory Networks, *Selected Talk: The 1st q-Bio Conference on Cellular Information Processing*, Santa Fe, NM, Aug. 2007.

Book Chapter

⋄ M. Khammash and B. Munsky, Stochastic Gene Expression: Modeling, Analysis, and Identification, To appear in B. Levine, *The Control Handbook, Second Edition*, Taylor & Francis Group, New York, NY.

Teaching and Tutoring Experience

⋄ **Summer School Co-organizer and Theme Leader**, Los Alamos National Laboratory.
I am organizing the theme on stochastic biochemistry for the 2010 q-bio Summer School on Cellular Information Processing. My duties include designing the theme syllabus, choosing and inviting external lecturers, advertising and recruiting students, allocating scholarship money, designing and giving lectures and homework assignments, and others.
School website: http://cnls.lanl.gov/q-bio/summer_school.html.

⋄ **Course Development and Teaching**, Department of Mechanical Engr., UC-Santa Barbara.
Together with Mustafa Khammash, I co-developed and co-taught a new graduate level course on the modeling and analysis of stochastic gene regulatory networks. Duties included researching material, preparing and giving lectures, and assigning and grading homework and exams (Spring, 2007).

⋄ **Graduate Teaching Assistant**, Department of of Aerospace Engineering, Penn State University.
As a teaching assistant of a course on the numerical analysis of aerospace structures, I prepared and delivered weekly review sessions; assigned, solved, and graded biweekly homework assignments; and provided group and one-on-one tutoring to students (Spring, 2001).

⋄ **Writing Tutor**, University Learning Resource Center, Penn State University.
As a trained peer tutor for writing, I assisted undergraduate, graduate and ESL (English as a Second Language) students at the Penn State Writing Center (Jan.–Dec. 1997).

Tutorials and Lectures

⋄ B. Munsky, Stochastic effects in systems biology: Theoretical Foundations and Experimental Results, Part I and II, *The 2nd q-Bio Summer School on Cellular Information Processing*, Los Alamos, NM, Jul.-Aug. 2008 (Also updated and presented at *The 3rd q-Bio Summer School on Cellular Information Processing*, Los Alamos, NM, Jul.-Aug. 2009).

⋄ B. Munsky and M. Khammash, Stochastic Gene Expression in Systems Biology, *The 2nd q-Bio Conference on Cellular Information Processing*, Santa Fe, NM, Aug. 6, 2008.

⋄ M. Khammash and B. Munsky, Stochastic Gene Expression in Systems Biology, *The 8th International Conference on Systems Biology*, Long Beach, CA, Oct. 2007.

Professional Activities

⋄ Co-Organizer of *The 3rd Workshop on Stochasticity in Biochemical Reaction Networks* to be held at the Banff International Research Station (BIRS) in Banff, Canada, Sept. 11-16, 2011. **Registration, lodging and meals paid for all 42 participants through competitive BIRS grant**.

⋄ Co-Organizer of *The 2nd Workshop on Stochasticity in Biochemical Reaction Networks* at BIRS in Banff, Canada on Sep. 25-27, 2009. **Registration, lodging and meals paid for all 25 participants through competitive BIRS grant**.

⋄ Co-Organizer of *The 2009-10 Center for NonLinear Studies q-bio Seminar Series*, Los Alamos National Laboratory. Duties include choosing, inviting, scheduling and arranging funding for external visitors.

⋄ Referee for *Automatica*, *Journal of Physics A: Mathematical and Theoretical*, *Physics Letters A*, *The IEEE Conference on Decision and Control*, *The IEEE American Controls Conference*, *The IFAC Symposium on System Identification*, *IET Systems Biology*, *Biotechnology Progress*, *PLoS Computational Biology*, and *Smart Materials and Structures*.

⋄ Member of the Institute of Electrical and Electronics Engineers (IEEE), American Physical Society (APS), the American Association for the Advancement of Science (AAAS), the Society for Industrial and Applied Mathematics (SIAM), and the International Society for the Advancement of Cytometry (ISAC).

Honors and Awards

◇ 2010 Leon Heller Postdoctoral Publication Prize at the Los Alamos National Laboratory

◇ Richard P. Feynman Postdoctoral Fellowship at the Los Alamos National Lab (Feb. 2010-2013)

◇ Director's Postdoctoral Fellowship at the Los Alamos National Lab (July 2008-2010)

◇ UCSB Department of Mechanical Engineering Best Ph. D. Dissertation Award for 2007-08

◇ Best Presentation in Session, 27th American Controls Conference in Seattle, WA, (June 2008)

◇ American Controls Conference Student Travel Award (2007, 2008)

◇ University of California Student Travel Grant (2007)

◇ UCSB Chancellor's Fellowship (Sep. 2003–May 2008)

◇ UCSB Department of Mechanical Engineering Graduate Fellowship (Sep. 2003–May 2008)

◇ National Defense Science and Engineering Graduate (NDSEG) Fellowship (2001–2002)

◇ Penn State Schreyer Ambassador Travel Grant (1999)

◇ American Helicopter Society Vertical Flight Foundation Award (Twice: 1999, 2000)

◇ Penn State University College of Engineering Graduate Fellowship (2000–2001)

◇ Mary Ilgen Memorial Scholarship (1999–2000)

◇ Graduated with Honors from the Penn State Schreyer Honors College (May 2000)

◇ Penn State Deans List (7 times)

◇ Schreyer Honors College Academic Excellence Award (1996-2000)

Skills

◇ **S**ystems and Control theory based modeling and analysis techniques for biological systems. These include tools for sensitivity and robustness analysis, model reduction, and parameter identification for complex bio-networks.

◇ **N**umerical methods for stochastic systems: stochastic simulations, τ leaping, hybrid methods, Stochastic Differential Equations, Finite State Projection reductions for master equations, and others.

◇ **N**umerical analyses of PDEs using finite difference, finite element, Raleigh-Ritz, and other approaches.

◇ **C**/C++, Fortran, Matlab, Unix, Linux, MS-Windows, Mac OS X, LaTeX, Maple, Mathematica and others.

References

◇ Available upon request.